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A "Cartbench" and Track System for Greenhouse Production of Containerized Tree Seedlings

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A strong, lightweight "cartbench" and track system was designed to best utilize space, facilitate procedures, and incorporate components involved in greenhouse production of containerized seedlings. This system has worked successfully in three plastic greenhouses at the USDA Forest Service Shelterbelt Laboratory, Bottineau, North Dakota.

Keywords: Cartbench, greenhouse components.

Introduction and Discussion

Greenhouse systems for growing containerized tree seedlings are gaining rapid acceptance.² Expenses involved in greenhouse operations where growing conditions are controlled put a premium on the space available for production.³ One space-consuming component is ductwork for moving large volumes of air for root-pruning and maintaining uniform air temperatures. Conventional stationary greenhouse benches also waste too much lateral aisle space.

To facilitate access to each seedling and best utilize valuable greenhouse space, a strong, lightweight "cartbench" and track system was designed that

incorporates an airflow system. Wood-slat bench tops supported by frames made from electrical conduit (fig. 1) ride on a simple wheel and track system (fig. 2). Flanged wheels are inexpensive combine-idler pulleys. Plastic sleeve heating ducts run along the floor below cross braces of the cartbench frame (fig. 3). Individual cartbenches can be rolled apart to create lateral aisles when necessary. Extending the track system beyond removable panels in the end wall gives forklift flexibility for moving seedlings from one greenhouse to another.

The cartbenches were constructed for a specific greenhouse design, heating system, and seedling container, but the whole concept can be adapted to most containerized greenhouse systems. The cartbench was constructed to hold 27 pallets of Spencer Lemaire Roottrainers. Each pallet contained 40 cavities of the "Tinus" (25 in³) size.

Materials and Procedures

Basically, the cartbenches are wooden racks built from 2- by 2-inch wooden supports bolted to ¾-inch conduit frameworks with ½-inch conduit braces and 4 wheel assemblies made from combine-idler pulleys.

The track system was designed with 2- by 8-inch ties 6 feet long spaced 2 feet apart. The tracks run the length of the greenhouse and extend the width of one cartbench beyond the end wall. Rails were made

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²Tinus, R. W. Observations and new information on greenhouse container systems. Presented at annual meeting Intermt. Nurserymen's Assoc. Meet.; Missoula, Mont., Aug. 5-7, 1975.

³Vyse, A. H., and D. E. Ketcheson. 1974. The cost of raising and planting containerized trees in Canada. p. 402-411. Proc. North Am. Containerized For. Tree Seedling Symp. [Denver, Colo., Aug. 1974]. Great Plains Agric. Coun. Publ. 68.

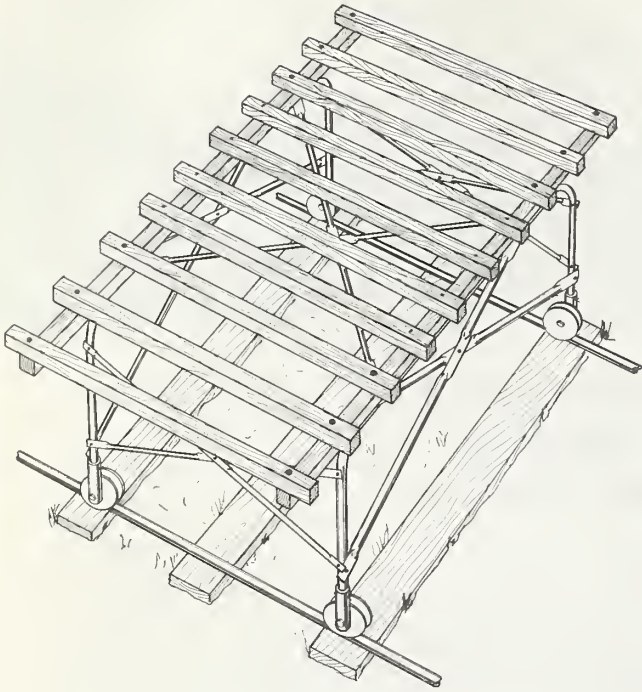


Figure 1.—Cartbench top and conduit frame.



Figure 2.—Simple flanged wheel and track system.



Figure 3.—Heating duct and cartbench crossbraces.



Figure 4.—Wheel assembly.

of $\frac{3}{4}$ -inch heavy duty well pipe. To keep rails parallel, notches in the ties $1\frac{1}{8}$ inches wide were sawed $\frac{1}{2}$ inch deep and $67\frac{1}{2}$ inches apart.

The wheel assemblies were made using a 6-inch length of 1-inch heavy duty well pipe (fig. 4). A $\frac{1}{2}$ -inch hole was drilled 1 inch from an end, and a 4- by $\frac{1}{2}$ -inch machine bolt was inserted for the wheel axle. A $1\frac{1}{16}$ inch length of $\frac{1}{2}$ -inch conduit was used as a bushing. The plastic wheel was slipped over the bushing, and a large $\frac{1}{2}$ -inch washer was added. A locking washer and nut were tightened, forcing the bushing to shorten and conform to the shape of the well pipe.⁴

The ends and cross points of the cartbench end and cross braces were flattened in a large vise and drilled for $\frac{1}{4}$ -inch bolts. (Cross points for end braces are centered; for cross braces, they are off-centered.) The two pairs of braces were fastened loosely at their cross points with $\frac{3}{4}$ - by $\frac{1}{4}$ -inch stove bolts. Two 10-foot lengths of $\frac{3}{4}$ -inch conduit with 90° bends 2 feet from each end were used for the main side frame and legs.

Jigs were essential to maintain uniformity when the various components of the cartbench were

assembled. The cartbench jig was made with two 8-foot lengths of 6- by 6-inch stringers and a 4- by 8-foot sheet of $\frac{3}{4}$ -inch plywood. The plywood was centered on the stringers and nailed in place; $\frac{3}{4}$ -inch holes were drilled through the stringers to hold each leg. Holes were 4 feet apart in width and 5 feet, $11\frac{1}{4}$ inches apart in length. The jig held the main side frame and legs in place while the cross and end braces were added and secured with $1\frac{1}{2}$ - by $\frac{1}{4}$ -inch stove bolts (fig. 5). The cross braces rested on the jig when bolted in place. The main support stringers were clamped in place while being drilled. Two 6- by $\frac{1}{4}$ -inch stove bolts, $53\frac{1}{2}$ inches apart, held them in place. These bolts also held two support rails which were added next. The 6-inch stove bolts also held the top cross braces, which were drilled in place by holding them beneath the holes in the 2- by 2-inch supports. To prevent splitting the two end support rails, 4- by $\frac{1}{4}$ -inch stove bolts were used. The remaining six support rails were drilled to prevent splitting and then nailed with 8-penny box nails. Bolts were then tightened, and the cartbench was removed from the jig. The wheel assemblies were slipped onto the legs, the cartbench was alined on the track, and the wheel assemblies were fastened with cotter pins.

Material costs of \$32.57 for constructing a cartbench and \$1.98 per foot of track system reflect local January 1976 prices (table 1). Roughly $\frac{1}{2}$ man-day was required to construct a cartbench in the jig.

⁴Boston Bronze Bushings and aluminum alloy wheels are now available at approximately \$20 per cartbench from State Machine Products, P.O. 292, Stevensville, Mont. 59870.



Figure 5.—Cartbench jig construction and assembly of end and side braces to main side frame and legs.

Table 1.—Material descriptions and costs

Quantity	Part	Purpose	Unit cost	Total cost
CARTBENCH:				
(Electrical conduit)				
2	¾-inch, 120 in.	Main side frames and legs	\$ 5.00	
4	¾-inch, 60 in.	Cross braces for main side frame and legs	5.00	
2	¾-inch, 74 in.	Top cross braces	3.08	
4	½-inch, 51 in.	End braces	3.06	\$16.14
(Lumber)				
2	2- by 2-inch, 98 in.	Main support stringers	1.96	
10	2- by 2-inch, 54 in.	Support rails	5.40	7.36
(Hardware for frame)				
Stove bolts:				
4	¼-inch, 6 in.	Main support stringer, support rail, and top cross brace fasteners	0.48	
4	¼-inch, 4 in.	End support rail fasteners	.34	
16	¼-inch, 1½ in.	Cross and end brace fasteners	.64	
4	¼-inch, ¾ in.	Cross point brace fasteners	.12	
12	Nails, 8-penny, box, galvanized		.10	
4	Cotter pins, 1/8-inch, 2 in.	Attaching wheel assemblies	.06	
28	Nuts, ¼ inch		.84	2.58
(Hardware for wheel assemblies)				
4	Wheels, plastic, fiberglass-reinforced flanged		3.80	
4	Pipe, heavy duty well, 1-inch, 6 in.		1.10	
4	Bolts, machine, ½-inch, 4 in.	Wheel axle	1.00	
4	Nuts, hex, ½-inch		.24	
4	Washers, flat, ½-inch		.12	
4	Washers, locking		.12	
4	Conduit bushing, ½-inch, 1 9/16 in.		.11	6.49
Total cost of one cartbench				\$32.57
TRACK SYSTEM:				
	Ties, 2- by 8-inch, 6 ft.		2.07	
	Pipe, heavy duty well, ¾-inch, 21 ft.		9.87	
Total cost of track system per running foot				1.98
JIG:				
(Lumber)				
2	6-by 6-inch, 8 ft.		25.44	
1	Plywood sheet, ¾-inch, 4 by 8 ft.		10.95	
Total cost of jig construction				\$36.39

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